NOTICE

All drawings located at the end of the document.

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EG&G

ROCKY FLATS

Final Technical Memorandum No.3 Addendum to Final Phase I RFI/RI Work Plan Surface Soil Sampling Plan - Original Landfill Operable Unit No.5

January 1993

FINAL
TECHNICAL MEMORANDUM NO. 3

ADDENDUM TO FINAL PHASE I RFI/RI WORK PLAN

Surface Soil Sampling Plan - Original Landfill

Rocky Flats Plant
Woman Creek Priority Drainage

(Operable Unit No. 5)

EG&G ROCKY FLATS, INC.
P.O. Box 464
Golden, Colorado 80402-0464

Prepared for:

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

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RFI/RI WORK PLAN TECHNICAL MEMORANDUM
APPROVAL SHEET

EG&G ROCKY FLATS PLANT

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Surface Soil Sampling Plan - Original Landfill
Rocky Flats Plant
Worman Creek Priority Drainage

Approved By:

E O Mast — 8/4/94
OU5,6&7 Closures Program Manager — Date

[signature] — 8/16/94
OU5 Project Manager — Date

[signature] — 9/1/94
ER QA Program Manager — Date

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n/a
Name (Date)

DRAFT TECHNICAL MEMORANDUM
SURFACE SOIL SAMPLING PLAN

1.0 INTRODUCTION

1.1 BACKGROUND

As part of the Rocky Flats Environmental Restoration program, a multiple-staged Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) is being conducted for Operable Unit 5 (OU5). Located within OU5 is Individual Hazardous Substance Site (IHSS) 115, the Original Landfill for the Rocky Flats Plant. IHSS 115 was in service from 1952 to 1968 and was used as a disposal site for general plant wastes which may have included 1,1,1-trichloroethane, dichloromethane, benzene, paint and paint thinners, oil, pesticides, beryllium, uranium, lead and chromium (DOE, 1992).

IHSS 115 is being evaluated in a 5-stage effort as part of the Phase I RFI/RI Work Plan. The 5 stages are summarized as follows: Stage 1 - review of existing data; Stage 2 - field screening surveys; Stage 3 - multimedia surface sampling; Stage 4 - multimedia subsurface sampling; and Stage 5 - additional sampling as needed based on the unique characteristics of the IHSS.

During Stage 1, aerial photographs as well as the operational history of the landfill and field investigations by the Colorado Department of Health (CDH) and the Environmental Protection Agency (EPA) were used to redefine the boundary of the landfill. The redefined landfill boundary and the previous boundary are shown in Figure 1. Approximately 446,000 square feet are encompassed by the landfill over elevations ranging from approximately 5,940 feet to 6,050 feet above mean sea level.

1.2 PURPOSE AND SCOPE

A surface soil sampling program is proposed as part of the Stage 3 RFI/RI field activities for IHSS 115, the original landfill. The purpose of the surface soil sampling program is to characterize radiological and chemical parameters within the landfill cover for risk assessment and to investigate contaminant anomalies identified in the Stage 1 data review and Stage 2 field screening surveys (DOE, 1992). The primary purpose of Technical Memorandum 3 (TM3) is to specify the Stage 3 surface soil sample locations and the locations of surface soil samples to be collected at areas exhibiting radioactivity above natural background (hot spots). It is being proposed now to make the soil sampling plan a two-phased plan. The first phase would commence on the approval of TM3 as outlined herein. The second phase, if necessary, would be completed at the conclusion of the electromagnetic, magnetic and soil organic vapor (SOV) surveys. This approach is suggested to (1) expedite the soil sampling at IHSS 115 and (2) to help to alleviate the bottleneck currently being experienced at the analytical laboratories by potentially spreading sample collection over a longer period of time by starting work earlier. If after a review of the electromagnetic, magnetic and SOV surveys, the areal extent of the landfill is increased, a Technical Memorandum will address those changes and if necessary a second phase soil sampling program will be implemented. If the boundary of the landfill does not change based upon this information or is decreased in size, there will be no additional soil sampling.

2.0 PRELIMINARY FIELD ACTIVITIES

Stage 1 preliminary data gathering activities have been completed. The Aerial Photographic Analysis Comparison Report, US DOE Rocky Flats, Golden Colorado, Appendix A, EPA Region 8 (EPA, 1988) has been reviewed, and a series of oblique aerial photographs intermittently spanning the period of February 6, 1966 to June 26, 1991 have also been reviewed. The results of a 1990 gamma radiation survey as published in Volume II of the OU5 Phase I RFI/RI Work Plan have been reviewed.

2.1 AERIAL PHOTO REVIEW

Dimensions and boundaries of the original landfill have been estimated from aerial photos and have been transferred to a 1" = 200' scale map of the site (Figure 1). The conclusions drawn from the aerial photo review are summarized below.

1. A suspect area shown as disturbed ground and a possible pit off the west end of IHSS 115 has been included within the investigation area of IHSS 115.

2. The surface disturbance east of the landfill (Figure 1) has been enlarged to include an area interpreted as rubble east of the road on the east side of the surface disturbance. This interpretation is based on an evaluation of the aerial photographs, in particular oblique photographs taken in December, 1987 that clearly define the rubble piles. This is now being interpreted as material used to construct a collection basin for the discharge outlet for the outfall pipe shown on Figure 1.

3. The initial outfall pipe (Figure 1) was constructed in 1986 and was extended to the south by a corrugated metal flume. The buried outfall pipe (Figure 1) extending to the southeast was added in either 1987 or 1988. The construction of

both pipes would have resulted in the displacement and reburial of a substantial amount of landfill material.

4. The drainage ditch shown to the east of the outfall pipes was visible on vertical aerial photographs from 1955 through 1981 and was apparently covered or partially filled by 1983. The ditch is clearly visible on oblique photographs taken in 1967 and 1969 which show a culvert under the railroad tracks and probably under the main road. There is no photographic evidence that the culvert was removed, sealed, or extended before the ditch was covered.

5. The berm shown to the south of the west end of the landfill is under construction in oblique photographs taken on November 15, 1967. Oblique photographs taken on June 5, 1969, July 11, 1969, and May 15, 1970 show the area behind the berm (north side) in various stages of being filled with rubble and a number of large unidentifiable objects. It may be significant to note that one of the U^{238} anomalies detected by the HPGe survey occurred just to the south of this berm.

6. Oblique photographs show that the pond identified on the 1955 vertical aerial photograph and interpreted to be filled in on subsequent photographs is now interpreted to have been completely washed out in later years. Consequently, any sludge or sediments that would have accumulated when the pond was in use (indicated filter backwash site) may have spread out below the pond site or been deposited in Woman Creek prior to the construction of the South Intercepter Ditch (SID).

7. Aerial photographs indicate that the landfill was operated as an area fill. Waste appears to have been dumped over the southern edge of the alluvial pediment on which the plant site is located and spread over the southerly facing slopes incised by Woman Creek. Groundtruthing conducted as part of the aerial photo review

process suggests that the landfill cover is intact above the topographic break described above. Below the topographic break, the cover appears to be eroded with numerous slumps which locally expose some of the waste.

2.2 RADIATION SURVEY

During the period of October 25, 1990 to December 8, 1990, a gamma radiation survey was conducted over the original landfill using a 20 percent N-type, high purity germanium (HPGe) detector (DOE, 1992). The survey data is presented in Volume II of the Phase I RFI/RI Work Plan. Review of the data contained in the Work Plan indicates that activity from most of the detected isotopes was consistent with natural background; however, there were areas that exhibited elevated U^{238} activity (hot spots). These hot spots are shown on Figure 2.

The conclusions drawn from the HPGe survey are summarized below.

1. Volume II, Appendix B, Figure 5 of the OU5 Work Plan shows contours for a large anomaly located over the central portion of the landfill. This anomaly encompasses survey stations C-8, C-9, B-7 and B-8 shown on Figure 2. This anomaly may be a composite of point sources, although this can not be determined from the available data. The contours on Figure 2 are provided to give the reader a visual impression of anomalous areas. Anomalies herein are referenced to stake coordinates listed in Volume II, Appendix B, Table 2 of the OU5 Work Plan.

2. Anomalies D-3 and P-2 detected to the south and east of the landfill respectively appear to be related to landfill material that was excavated during the construction of the SID.

3. The location and source for the anomaly at SP-2 is documented by photographs 19, 20 and 21 in a volume entitled "Photographs of Woman Creek, OU5". The description for one of the photographs includes the coordinates (with a typographical error) of the source, which exactly coincide with the coordinates of SP-2. The photographs show the object known to be the source for SP-2 protruding through the landfill.

4. All of the indicated U^{238} occurrences along the "W" line (survey points W-2, W-8 and W-11), which extends along the north bank of Woman Creek, appear to be related to natural features which drain into the creek. The locations of the B-7, B-8, C-8, C-9, D-3, P-2, and SP-2 hot spots have been land surveyed and marked with stakes. Sample locations for the "W" line hot spots will be identified in the field by means of a compass, measuring tape and surveyed markers installed as part of the geophysical and SOV surveys. State plane coordinates for each of the hot spots are listed in Table 1 and surface soil samples will be collected at these locations.

2.3 GEOPHYSICAL SURVEYS

Magnetometer and electromagnetic (EM) surveys will be conducted on and downgradient of the original landfill. The surveys will also cover the disturbed area to the east of the original landfill. The surveys may provide additional information regarding the areal extent of the original landfill. If the areal extent of the landfill extends beyond the current projected boundary, an additional soil sampling program may be required. If the areal extent of the landfill is increased, a Technical Memorandum will address the new boundaries and the need for additional soil sampling. Initiating the soil sampling program prior to full analysis of the electromagnetic, magnetic and SOV survey will help in making up lost time caused by other delays already experienced in implementation of the OU5 Work Plan.

TABLE 1

RADIATION HOT SPOTS AND DISTURBED AREA SURFACE SOIL SAMPLE LOCATION NUMBERS STATE PLANE COORDINATES AND SAMPLE NUMBERS - IHSS 115

Sample No.	Surface Soil Sample Location No.	Hot Spot Survey No.	State Plane Coordinates	
SS50001AS	SS505093	SP-2	E2081190	N747882
SS50002AS	SS505193	D-3	E2081194	N747564
SS50003AS	SS505293	B-7	E2081794	N747865
SS50004AS	SS505393	C-8	E2081944	N747715
SS50005AS	SS505493	B-8	E2081994	N747864
SS50006AS	SS505593	C-9	E2082094	N747714
SS50007AS	SS505693	P-2	E2082336	N747656
SS50008AS	SS505793	W-2	E2080905	N747262
SS50009AS	SS505893	W-8	E2081944	N747408
SS50010AS	SS505993	W-11	E2082425	N747471
SS80001AS*	SS505993	W-11	E2081425	N747471

* Duplicate sample

The last 2 digits of the sample location number (92) may change to 93 based upon the year the sample is collected.

2.4 SOIL ORGANIC VAPOR SURVEY

A real-time soil organic vapor (SOV) survey will be conducted over the original landfill and the disturbed area to the east of the landfill. The SOV survey will be used to identify plumes of volatile contaminants that may be present beneath and downgradient of the original landfill. The results of the SOV will assist in the selection of locations for soil borings conducted during Stage 3 investigation activities.

3.0 SURFACE SOIL SAMPLING PROGRAM

3.1 SOIL SAMPLE LOCATIONS - LANDFILL

Radiation anomalies and the areal extent of the original landfill have been defined based upon the Stage 1 data review activities described above. Surface soil sampling activities will focus on the radiation hot spots, the landfill cover material and the disturbed area to the east of the landfill.

Ten hot spots were identified during the review of the 1990 gamma radiation survey. As explained in Section 2.2, Item 3, the source for the anomaly at SP-2 is documented; therefore, with the exception of hot spot SP-2, one surface soil sample will be collected near the center of each of the 1990 gamma radiation survey hot spots (Figure 2) using the Rocky Flats surface soil sampling methods described in EG&G Operating Procedure GT.8. One surface soil sample will be collected downgradient of the source for SP-2 to determine if runoff has transported contamination from the source. The source for SP-2 protrudes through the ground; therefore, sample locations for SP-2 will be determined in the field at the time of sampling based upon health and safety considerations. Samples collected from hot spots will be analyzed for those radionuclides shown in Table 2.

TABLE 2

IHSS 115
ANALYTICAL PARAMETERS

TARGET ANALYTE LIST - METALS	DETECTION LIMITS Soil (mg/kg)
Aluminum	40
Antimony	12
Arsenic	2
Barium	40
Beryllium	1.0
Cadmium	1.0
Calcium	2000
Cesium	200
Chromium	2.0
Cobalt	10
Copper	5.0
Cyanide	10
Iron	20
Lead	1.0
Lithium	20
Magnesium	2000
Manganese	3.0
Mercury	0.2
Molybdenum	40
Nickel	8.0
Potassium	2000
Selenium	1.0
Silver	2.0
Sodium	2000
Strontium	40
Thallium	2.0
Tin	40
Vanadium	10.0
Zinc	4.0

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

BASE NEUTRAL EXTRACTABLES - SEMIVOLATILES	QUANTITATION LIMITS* Soil (ug/kg)
bis(2-Chloroethyl) ether	330
1,3-Dichlorobenzene	330
1,4-Dichlorobenzene	330
Benzyl Alcohol	330
1,2-Dichlorobenzene	330
2-Methylphenol	330
bis(2-Chloroisopropyl) ether	330
4-Methylphenol	330
N-Nitroso-di-n-dipropylamine	330
Hexachloroethane	330
Nitrobenzene	330
Isophorone	330
Benzoic Acid	1600
bis(2-Chloroethoxy) methane	330
1,2,4-Trichlorobenzene	330
Naphthalene	330
4-Chloroaniline	330
Hexachlorobutadiene	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	330
2-Methylnaphthalene	330
Hexachlorocyclopentadiene	330
2,4,5-Trichlorophenol	1600
2-Chloronaphthalene	330
2-Nitroaniline	1600
Dimethylphthalate	330
Acenaphthylene	330
2,6-Dinitrotoluene	330

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

BASE NEUTRAL EXTRACTABLES - SEMIVOLATILES	QUANTITATION LIMITS* Soil (ug/kg)
3-Nitroaniline	1600
Acenaphthene	330
Dibenzofuran	330
2,4-Dinitrotoluene	330
Diethylphthalate	330
4-Chlorophenyl Phenyl ether	330
Fluorene	330
4-Nitroaniline	1600
4,6-Dinitro-2-methylphenol	1600
N-nitrosodiphenylamine	330
4-Bromophenyl Phenylether	330
Hexachlorobenzene	330
Phenanthrene	330
Anthracene	330
Di-n-butylphthalate	330
Fluoranthene	330
Pyrene	330
Butylbenzylphthalate	330
3,3'-Dichlorobenzidine	660
Benzo(a)anthracene	330
Chrysene	330
bis(2-Ethylhexyl)phthalate	330
Di-n-octylphthalate	330
Benzo(b)fluoranthene	330
Benzo(k)fluoranthene	330
Benzo(a)pyrene	330
Indeno(1,2,3-cd)pyrene	330
Dibenz(a,h)anthracene	330
Benzo(g,h,i)perylene	330

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

TARGET COMPOUND LIST - PESTICIDES/PCBS	QUANTITATION LIMITS* Soil (ug/kg)
alpha-BHC	8.0
beta-BHC	8.0
delta-BHC	8.0
gamma-BHC (Lindane)	8.0
Heptachlor	8.0
Aldrin	8.0
Heptachlor epoxide	8.0
Endosulfan I	8.0
Dieldrin	16.0
4,4'-DDE	16.0
Endrin	16.0
Endosulfan II	16.0
4,4'-DDD	16.0
Endosulfan sulfate	16.0
4,4'-DDT	16.0
Methoxychlor	80.0
Endrin ketone	16.0
alpha-Chlordane	80.0
gamma-Chlordane	80.0
Toxaphene	160.0
Aroclor-1016	80.0
Aroclor-1221	80.0
Aroclor-1232	80.0
Aroclor-1242	80.0
Aroclor-1248	80.0
Aroclor-1254	160.0
Aroclor-1260	160.0

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

RADIONUCLIDES	REQUIRED DETECTION LIMITS* Soil (pCi/g)
Gross Alpha	4 dry
Gross Beta	10 dry
Uranium 233+234, 235, and 238 (each species)	0.3 dry
Americium 241	0.02 dry
Plutonium 239+240	0.03 dry
Tritium	400 (pCi/ml)
Cesium 137	0.1 dry
Strontium 89+90	1 dry

* Detection and quantitation limits are highly matrix dependent. The limits listed here are the minimum achievable under ideal conditions. Actual limits may be higher.

OTHER PARAMETERS	REQUIRED DETECTION
Bulk Density	0.1 gm/cm^3
Particle Size Analysis	+200 sieve
Specific Conductance	2.5 umoh/cm
Carbonate	2 mg/kg
pH	0.1 Ph units
Total Organic Carbon	1 mg/kg

In accordance with Section 7.2.1 of the OU5 Work Plan, at least three surface soil samples will be collected from the disturbed area to the east of the original landfill. The sample locations were selected by overlaying a grid of 52 sequentially numbered cells with map scale dimensions of 50 feet by 50 feet on a map of the study area. The RANDOMIZE and RND functions of Quick Basic were used to generate three random numbers in the range of 1 to 52 as follows.

```
10 RANDOMIZE (random number seed 212)
20 FOR J= 1 TO 3
30 L=INT(52*RND(1))+1
40 PRINT L
50 NEXT J
```

Three grid cells corresponding to the numbers generated by Quick Basic were selected as the proposed sample locations (sample numbers 112, 113 and 114 shown on Figure 3). These samples will be collected according to the Rocky Flats soil sampling method and analyzed for both the radionuclides and conventional analytes shown in Table 2.

In addition to the samples described above, surface soil sampling will be used to characterize the radiological and chemical concentrations in the landfill cover for risk assessment. A total of 51 surface soil samples will be collected at 100-foot grid spacings (Figure 3). The surface soil sampling program was developed in accordance with applicable EPA guidance, including:

- Soil Sampling Quality Assurance User's Guide - Second Edition (EPA/600/8-89/046), March 1989 (EPA, 1989a);
- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (EPA/540/P-91/001), February 1991 (EPA, 1991);
- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A (EPA/540/1-89/002), December 1989 (EPA, 1989b); and
- Guidance for Data Usability in Risk Assessment (Publication 9285.7-09A), April 1992 (EPA, 1992).

Systematic grid sampling was selected because this procedure is useful for the range of statistical procedures which could be required for the assessment of soil contact exposures. Statistical procedures which could be required depend on the spatial distribution of chemical and radiological parameters in the landfill cover. The statistical procedures which could be required and which are supported by systematic sampling include:

1) geostatistical estimation of local concentrations (i.e., in portions of the landfill cover). Local concentration estimates will differ from the global (i.e., total landfill area) average if concentrations are spatially variable. If concentrations are elevated within potential exposure areas (i.e., portions of the landfill where activity could be concentrated), local estimates would be useful in calculating the reasonable maximum exposure (RME); and

2) classical estimation of the average concentration and 95 percent upper confidence limit (UCL) of the average across the landfill cover. Classical estimation is appropriate for calculating RME where concentrations are evenly distributed (i.e., no patterns of spatial variation are evident).

The 100-foot grid spacing was selected based on the spatial distribution of the HPGe data for radiological parameters in the landfill cover, the likely spatial distribution of the chemical parameters, and the potential activity patterns in which the landfill cover material would be contacted. Each of these factors is discussed below.

HPGe Data for Radiological Parameters

With the exception of U-238, radiological parameters in the HPGE data were evenly distributed across the site with low coefficient of variation. Because the HPGE data indicate that concentrations are likely to be evenly distributed, classical methods may be appropriate to

calculate the RME. Based on a total sample size of 51 and a low coefficient of variation, a precise estimate of the RME can be calculated.

The precision of the classical RME estimate is illustrated by a sample calculation for Thorium-232. The one-sided 95 percent UCL would be used for the classical RME estimate. Use of the UCL ensures that there is only a 5 percent chance that the true average concentration is underestimated.

The one-sided 95 percent UCL for the arithmetic average is calculated as follows (Gilbert, 1987):

$$UCL = \text{x-bar} + t_{0.95,n-1}s$$

where,

UCL = Upper confidence limit

x-bar = Arithmetic average concentration

$t_{0.95,n-1}$ = 95th percentile of the t-distribution with n-1 degrees of freedom

n = Number of samples

s = Standard error (i.e., the standard deviation divided by the square root of n)

sd = Standard deviation

From the Thorium-232 HPGe data,

x-bar = 1.35 pCi/g,

sd = 0.33

Using a proposed sample size of 51,

s = 0.05 pCi/g

From statistical tables,

$t_{0.95,50}$ = 1.68

Therefore, based on a proposed sample size of 51, the calculated UCL would be,

$$UCL = 1.35 + (1.68)(0.05)$$
$$= 1.35 + 0.08$$

Therefore, based on the HPGe data for Thorium-232, the calculated UCL would be only six percent (0.08/1.35) higher than the arithmetic average concentration.

Potential Distribution of Chemical Parameters

No data are available for the chemical parameters. However, possible localized areas of elevated concentrations could exist. Likely sources of spatial variation include:

- possible use of different soils for landfill cover material; and
- possible partial erosion of cover material in portions of the landfill.

From the likely sources of variation, localized areas of elevated concentrations (i.e., hot spots) would be associated with the landfill construction pattern and physical features. In particular, trends (i.e., spatial continuity) in concentrations may exist across adjacent cell areas, due to wind erosion patterns and also due to adjacent landfill cells being covered at similar times. The areal dimensions of the landfill cells are estimated to be 50 feet by 100 feet. Therefore, the 100-foot grid spacing will locate a sample within every second landfill cell area, so that localized spatial variation can be evaluated.

Potential Activity Patterns

Contact with landfill cover material would most likely occur through wind transport of particulates to adjacent areas. The 100-foot grid spacing will support local estimation on the 100-foot scale, so that the RME associated with potential future use activity patterns can be calculated.

The state plane coordinates of each proposed surface soil sample location are listed in Table 3. Sample locations will be identified in the field by means of a compass, measuring tape, and surveyed markers installed as part of the geophysical and SOV surveys. The location of each surface soil sample will be staked at the time the sample is collected and land surveyed at a later date. A total of five additional surface soil samples may be collected at locations where stained soil, stressed vegetation or other field indications of contamination are observed or detected. Data from the biased samples will not be used in the UCL calculations; however, if the samples are contaminated, the data will be used to direct further investigations. One field duplicate sample will be taken for every 10 soil samples collected and one rinsate sample will be collected for every 20 samples collected. These quality control sampling procedures are in accordance with the modified Quality Assurance Addendum to the OU5 Work Plan (DOE, 1992).

3.2 FIELD PROCEDURES

Field procedures for collecting surface soil samples are specified in EG&G Operating Procedure GT.8 (EG&G, 1992a). Samples collected for both radiological and conventional analysis will be collected according to the Rocky Flats method, Section 5.0 of GT.8 (EG&G, 1992a). Equipment needed for surface soil sampling is specified in GT.8 (EG&G, 1992a). Decontamination will be in accordance with EG&G Operating Procedure FO.3 (EG&G, 1992b). Sample labeling, shipment, and preservation will be conducted according to EG&G Operating Procedures FO.13 (EG&G, 1992c). Sample designations, documentation, data package preparation, and sample tracking will be in accordance with EG&G Operating Procedure FO.14 (EG&G, 1992d). Data Reduction, Validation and Reporting will be in accordance with Section 3.9 of the Quality Assurance Addendum to the OU5 Work Plan (DOE, 1992) and Section 3.4 of the Quality Assurance Project Plan (EG&G, 1991).

TABLE 3

RANDOM SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - IHSS 115

Sample No.	Surface Soil Sample Location No.*	State Plane Coordinates	
SS50011AS	SS506093	E2080850	N747795
SS50012AS	SS506193	E2080950	N747795
SS50013AS	SS506293	E2081050	N747795
SS50015AS	SS506493	E2081150	N747795
SS50016AS	SS506593	E2081150	N747695
SS50017AS	SS506693	E2081250	N747895
SS50018AS	SS506793	E2081250	N747795
SS50019AS	SS506893	E2081250	N747695
SS50020AS	SS506993	E2081350	N747995
SS50065AS***	NA	NA	NA
SS50066AS**	SS506993	E2081350	N747995
SS50021AS	SS507093	E2081350	N747895
SS50022AS	SS507193	E2081350	N747795
SS50023AS	SS507293	E2081350	N747695
SS50024AS	SS507393	E2081450	N747995
SS50025AS	SS507493	E2081450	N747895
SS50026AS	SS507593	E2081450	N747795
SS50027AS	SS507693	E2081550	N747995
SS50028AS	SS507793	E2081550	N747895

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.
** Duplicate Sample
*** Rinsate Sample
NA-Sample location number and state plane coordinates are not applicable to rinsate samples.
Sample number SS50014AS and sample location number SS506393 are void.

TABLE 3 - Continued
SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - ORIGINAL LANDFILL

Sample No.	Surface Soil Sample Location No.	State Plane Coordinates	
SS50029AS	SS507893	E2081550	N747795
SS50030AS	SS507993	E2081550	N747695
SS50067AS**	SS507993	E2081550	N747695
SS50031AS	SS508093	E2081550	N747595
SS50032AS	SS508193	E2081650	N747995
SS50033AS	SS508293	E2081650	N747595
SS50034AS	SS508393	E2081650	N747795
SS50035AS	SS508493	E2081650	N747695
SS50036AS	SS508593	E2081650	N747595
SS50037AS	SS508693	E2081750	N747995
SS50038AS	SS508793	E2081750	N747895
SS50039AS	SS508893	E2081750	N747795
SS50040AS	SS508993	E2081750	N747695
SS60068AS***	NA	NA	NA
SS50069AS**	SS508993	E2081750	N747695
SS50041AS	SS509093	E2081850	N748095
SS50042AS	SS509193	E2081850	N747995
SS50043AS	SS509293	E2081850	N747895
SS50044AS	SS509393	E2081850	N747795
SS50045AS	SS509493	E2081850	N747695

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.

** Duplicate Sample

*** Rinsate Sample

NA-Sample location number and state plane coordinates are not applicable to rinsate samples.

TABLE 3 - Continued
SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - ORIGINAL LANDFILL

Sample No.	Surface Soil Sample Location No.	State Plane Coordinates	
SS50046AS	SS509593	E2081850	N747595
SS50047AS	SS509693	E2081850	N747495
SS50048AS	SS509793	E2081950	N747995
SS50049AS	SS509893	E2081950	N747895
SS50050AS	SS509993	E2081950	N747795
SS50070AS**	SS509993	E2081950	N747795
SS50051AS	SS510093	E2081950	N747695
SS50052AS	SS510193	E2081950	N747595
SS50053AS	SS510293	E2081950	N747495
SS50054AS	SS510393	E2082050	N747995
SS50055AS	SS510493	E2082050	N747895
SS50056AS	SS510593	E2082050	N747795
SS50057AS	SS510693	E2082050	N747695
SS50058AS	SS510793	E2082050	N747595
SS50059AS	SS510893	E2082050	N747495
SS50060AS	SS510993	E2082150	N747995
SS50071AS***	NA	NA	NA
SS50072AS**	SS510993	E2082150	N747995
SS50061AS	SS511093	E2082150	N747895
SS50062AS	SS511193	E2082250	N747995
SS50063AS	SS511293	E2082340	N747825
SS50064AS	SS511393	E2082390	N748070
SS50073AS	SS511493	E2082590	N748025

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.

** Duplicate Sample

*** Rinsate Sample

NA-Sample location number and state plane coordinates are not applicable to rinsate samples.

A summary of surface soil sampling field methods is provided below. Details of the methods are given in the EG&G Operating Procedures.

1.0 The radiation survey results must satisfy the pre-work area radiation monitoring requirements and forms FO.16A and FO.16B must be completed - SOP FO.16.

2.0 The following decontamination equipment must be assembled for field use as required by FO.3: liquinox, bristle brushes (all plastic), Rocky Flats Plant tap water or distilled water, non-reactive plastic wrap, plastic wash and rinse tubs, plastic sheeting for use as a ground cloth, and paper towels.

3.0 The following sampling equipment must be obtained as required by FO.13: sample glassware with preservative (see Table 4), coolers, thermometer, blue ice, sample labels, chain of custody forms, custody seals, zip-lock bags, bubble wrap, vermiculite, strapping tape, clear tape, a carboy for transport of rinsate, and the forms included in Appendix I of this document.

Surface soil samples will be collected according to the Rocky Flats method. The following sample collection equipment must be obtained as required by GT.8: soil sampling jig (10 x 10 x 5 cm), spare sampling jig parts, stainless steel scoop, brushes, wire, paint, new 1 gallon metal paint cans, hammer, miscellaneous cold chisels, pointed cement trowel, black waterproof marking pens, metric rule, wood block (10 x 10 x 30 cm), site selection plan, health and safety equipment including PID and radiation survey instrument, and logbook.

4.0 Sampling equipment will be decontaminated in accordance with FO.3 and documented on form FO.3A. Disposal of decontamination water shall be in accordance with FO.7, Section 6.1.1. Steam cleaning of sample coolers and previously used disposal drums is required.

5.0 Sampling sites will be located using a steel tape, compass and survey monuments; coordinates for the sample locations are given in Table 3 of this document. Surface soil samples for radiological and conventional analyses will be collected in accordance with the Rocky Flats method, GT.8, section 5.2.3. Briefly, this method consists of compositing ten soil samples collected from the center and each corner of two one-meter squares that are spaced one meter apart at each sampling location.

All sampling activities will be documented in a field logbook and on forms GT.8A and GT.8B. Documentation will include the following items listed in EG&G Operating Procedure FO.13 section 6.4: sampling activity name and number, sampling point name and number, sample number, name(s) of collector(s) and

others present, date and time of sample collection, sample container tag/label number (if appropriate), preservative(s), requested analyses, sample matrix, filtered or unfiltered, designation of QC samples, collection methods, chain of custody control numbers, field observations and measurements during sampling, and signature.

Samples will be processed for shipment in accordance with FO.13 and the chain of custody (COC) form will be completed and a COC number assigned to it.

6.0 Field equipment will be decontaminated in between sample locations in accordance with FO.3; disposal of the leftover rinsate will be in accordance with FO.7, Section 6.1.1.

7.0 The data tracking process will be in accordance with FO.14 using form FO.14A. The data entry process will be as prescribed on forms FO.14C, FO.14H and FO.14K.

3.3 ANALYTICAL PARAMETERS

Based upon the types of waste that may have been disposed of in the landfill, each surface soil sample shown in Figure 3 will be analyzed for target analyte list (TAL) metals, total organic carbon (TOC), semi-volatiles (base neutral extractables), TCL pesticides, and a suite of radioanalytes specified in Table 2. Acid extractables will not be analyzed as specified in the OU5 Work Plan. This class of compounds has low adsorption coefficient (K_{oc}) values ranging from 27 to 900 and high water solubility (WS) values ranging from 14 to over 82,000 ppm. These values are indicative of chemicals that do not adsorb to soil ($K_{oc} < 1000$) and are mobile in the environment (WS > 10 ppm). Soil samples collected from hot spots identified during the review of the 1990 gamma radiation survey and shown in Figure 2 will be analyzed for the suite of radioanalytes specified in Table 2. Tritium exists in the environment as tritiated water. If it were in the surficial soils, it would have been removed by infiltration and runoff due to its high mobility in the environment. Therefore, tritium will not be analyzed as specified in the OU5 Work Plan. Samples will be collected for bulk density and particle size analyses and the results will be used in air transport modeling. Samples for specific conductance, pH, TOC and carbonate will be collected and the analyses will be used to assess contaminant mobility in soil.

All non-geotechnical analytical work will be conducted by an EG&G contract laboratory. Holding times, preservatives, and sample containers for each of the analytes are shown in Table 4.

TABLE 4

ANALYTES, SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Analyte	Container	Preservative	Holding Time
TAL Metals	Soil - 8oz. wide mouth glass jar.	None	6 months[a]
	Rinsate - 1 liter plastic bottle.	Nitric acid pH < 2 and Cool 4° C	6 months[a]
TOC	Soil - 8oz. wide mouth glass jar.	Cool 4° C	28 days
Semi-volatiles (base neutral extractables)	Soil - 8oz. wide mouth glass jar with Teflon liner.	Cool 4° C	7 days until extraction, 40 days post extraction.
	Rinsate - 4 liter amber glass bottle.	Cool 4° C	7 days until extraction, 40 days post extraction.
TCL Pesticides	Soil - 8oz. wide mouth glass jar with Teflon liner.	Cool 4° C	7 days until extraction, 40 days post extraction.
	Rinsate - 4 liter amber glass bottle.	Cool 4° C	7 days until extraction, 40 days post extraction.
Radiological Tests - gross alpha, gross beta, $U^{233/234}$, U^{235}, U^{238}, $Pu^{239/240}$, Am^{241}	Soil - 500 mL wide mouth glass jar.	None	None
	Rinsate - 3 x 4 liter plastic containers.	Nitric acid pH < 2	6 months

[a] Holding Time for Mercury is 28 days.

TABLE 4 - Continued

ANALYTES, SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Other Parameters	Container	Preservative	Holding Time
Bulk Density	1 Pint	None	Not Applicable
Particle Size Analysis	1 Pint	None	Not Applicable
Specific Conductance	8 oz	Cool 4°C	28 days
Carbonate	8oz	None	ASAP
pH	4oz	None	Immediately

4.0 REFERENCES

DOE (Department of Energy), 1992, Final Phase I RFI/RI Work Plan for Rocky Flats Woman Creek Priority Drainage (Operable Unit No. 5), Revision 1, February.

EG&G, 1991 Environmental Restoration Program (ERP) Quality Assurance Project Plan For CERCLA Remedial Investigations/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities, May 5, 1991.

EG&G, 1992a Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.9, Revision 2, Surface Soil Sampling, March 1, 1992.

EG&G, 1992b Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.3, Revision 2, General Equipment Decontamination, March 1, 1992.

EG&G, 1992c Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.13, Revision 2, Containerization, Preserving, Handling and Shipping of Soil and Water Samples, March 1, 1992.

EG&G, 1992d Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.14, Revision 2, Field Data Management, March 1, 1992.

EPA (Environmental Protection Agency), 1977, Sanitary Landfill Design and Operation, SW-65ts, Second Printing, November, 1977.

EPA (Environmental Protection Agency), 1986, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November, 1986.

EPA (Environmental Protection Agency), 1988, Aerial Photographic Analysis Comparison Report, US DOE, Rocky Flats, Golden, Colorado, Appendix A, EPA Region 8, TS-PIC-88760, July 1988.

EPA (Environmental Protection Agency), 1989a, Soil Sampling Quality Assurance User's Guide, (EPA/600/8-89/046), Second Edition, March, 1989.

EPA (Environmental Protection Agency), 1989b, Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A, (EPA/540/1-89/002), December, 1989.

EPA (Environmental Protection Agency), 1991, Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, (EPA/540/P-91/001), February, 1991.

EPA (Environmental Protection Agency), 1992, Guidance for Data Usability in Risk Assessment (Publication 9285.7-09A), April, 1992.

Gilbert, R.O., 1987, Van Norstrand Reinhold, Statistical Methods for Environmental Pollution Monitoring.

APPENDIX I

EG&G SAMPLE DOCUMENTATION FORMS

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM FO.16A (REV. 2)

RESULTS OF RADIOLOGICAL MEASUREMENTS IN THE FIELD

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____ Work Surface Wet (Y/N): _____

1. Instruments Used and Background Readings

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

2. Prework Monitoring Results (Ludlum 12)

_____ cpm at Point of Intrusive Activity _____ Highest Measured cpm

3. Sample Monitoring: Intervals Monitored and Associated Samples

Depth Interval (Ft)	Highest Level Noted (cpm)	Associated Sample Numbers

Completed By: _____
Print Name Signature Date

Subcontractor: _____

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM FO.16B (REV. 2)

RESULTS OF RADIOLOGICAL MEASUREMENTS IN THE FIELD

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____

1. Instruments Used and Background Readings

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

2. PPE Monitoring

_____ PPE monitoring not required. Work area was characterized as uncontaminated and field radiological screening as work progressed did not indicate the presence of potential contamination.

If PPE monitoring required complete the following table

Ludlum Model 12	Bicron Analyst Fidler	PPE screening resulted in verived positive reading (Y/N)	Time	PPE Verified positive reading (cmp)	Smear No.

Completed By: _____
Print Name Signature Date

Subcontractor: _____

EQUIPMENT DECONTAMINATION/WASH CHECKLIST AND RECORD

I. General Information completed by: ______________________________

Name Date Phone No.

____

Subcontractor's Name

NOTE: Sections I and II will be completed by the same individual.

Equipment Manufacturer, Model and Common Name: ______________________
Equipment Owner: ______________________
Name and Phone Number of Person Responsible for the Equipment: ______________________
Serial Number/Equipment Identification Number: ______________________
Delivered to Decontamination Station by: ______________________

Initial contaminate characterization of work area: (check one)

Not potentially contaminated ________
Potentially contaminated ________

II. Activity History

Where was equipment used? ______________________
What was equipment used for? ______________________
Types and volumes of water generated: (check as appropriate)

______ Purge ______ Gallons
______ Development ______ Gallons
______ Decon/Wash ______ Gallons
______ Rinse ______ Gallons

EQUIPMENT DECONTAMINATION/WASH CHECKLIST AND RECORD

III. Actions At Central Decontamination Station

Yes	No	
_____	_____	The equipment was washed under the provisions of SOP No. FO.3, General Equipment Decontamination
_____	_____	Personnel Decontamination Station established as described in the applicable site-specific health and safety plan
_____	_____	Personal protective equipment (PPE) selected based upon work area PPE level
_____	_____	Specify PPE level utilized: _____ Level B _____ Level C _____ Level D
_____	_____	PPE inspected prior to donning
_____	_____	Wind direction checked prior to using pressurized spray (circle the direction the wind was blowing from) N NE E SE S SW W NW
_____	_____	Was particular attention devoted to equipment parts that contacted potentially contaminated medium?
_____	_____	Was personal decontamination completed as described in the applicable site-specific health and safety plan?

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANTS FORM GT.8A (REV. 2)

SURFACE SOIL
DATA COLLECTION FORM

Sample Number _____

Collection Date _____

Collection Time _____

Location Code _____

Chain of Custody No. _____

Coordinates North or Y _____ East or X _____

Sample Location _____

Composite (Y/N) _____

Composite Description _____

Collection Method _____

Sample Team Leader _____

Sample Team Member _____

Sample Team Member _____

Sample Team Member _____

Container Size (Oz) _____ % Full _____

Comments _____

Completed By: _____
Print Name Signature Date

Subcontractor: _____

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANTS FORM GT.3B (REV. 2)

SURFACE SOIL SAMPLING FIELD ACTIVITIES REPORT

Project Name _____

Site Identification _____ Date _____

Sampler _____

SAMPLE POINT	GRID LOCATION	TIME	COMMENTS

Completed By: _____
Print Name Signature Date

Subcontractor: _____

CONTRACTOR _____ SAMPLERS _____ PROJECT # _____

SITE CONTACT/PHONE _____ LAB/LOCATION _____

C-O-C NUMBER

EG&G ROCKY FLATS, CHAIN OF CUSTODY

DATE/TIME		SAMPLE NUMBER	LOCATION	CONTAINER TYPE	NUMBER OF CONTAINERS	MEDIA SOIL(S) WATER (W)	FILTERED=F POT DISS=P	TURN AROUND RUSH =R	OUT OF SPEC REPORTS	PRESERVATIVE: COOLED TO 4 C	Zn(C2H3O2)2	NAOH	HNO3	H2SO4	BOTTLE CODES: V	V D C	B A R	P	M	M *	W A	W B C	W B D	W C	W D A	W D B	W E	W H	W I	W J	W K			
															VOA - CLP	VOA - 502.2	BNA - CLP	PCBs/PEST. - CLP	CLP TOTAL METALS(1)	CLP DISS. METALS(1)	WATER QUALITY (2)	NO3/NO2 as N	Tot. Phosphate, NH4	OIL & GREASE	Ortho-Phosphate	NO2	CYANIDE	TOC	DOC	H2S	Cr IV			

RELINQUISHED BY	DATE/TIME		RECEIVED BY	DATE/TIME	

REMARKS (1) INCLUDES Cs,Li,Sr,Mo,Si,Sn
(2) TSS,TDS,Cl,F,SO4,CO3,HCO3

SHIPMENT METHOD

LABORATORY USE ONLY	Y	N
PCKG REC'D/CUSTODY SEALS INTACT		
SAMPLE LABELS/COCs AGREE		
TEMPERATURE WITHIN SPECIFICATION _____C		
CORRECTED COPY ATTACHED		
PROBLEMS OR DISCREPANCIES		

CONTRACT _____ SAMPLERS _____ PROJECT # _____

SITE CONTACT/PHONE _____ LAB/LOCATION _____

C-O-C NUMBER

EG&G ROCKY FLATS, CHAIN OF CUSTODY

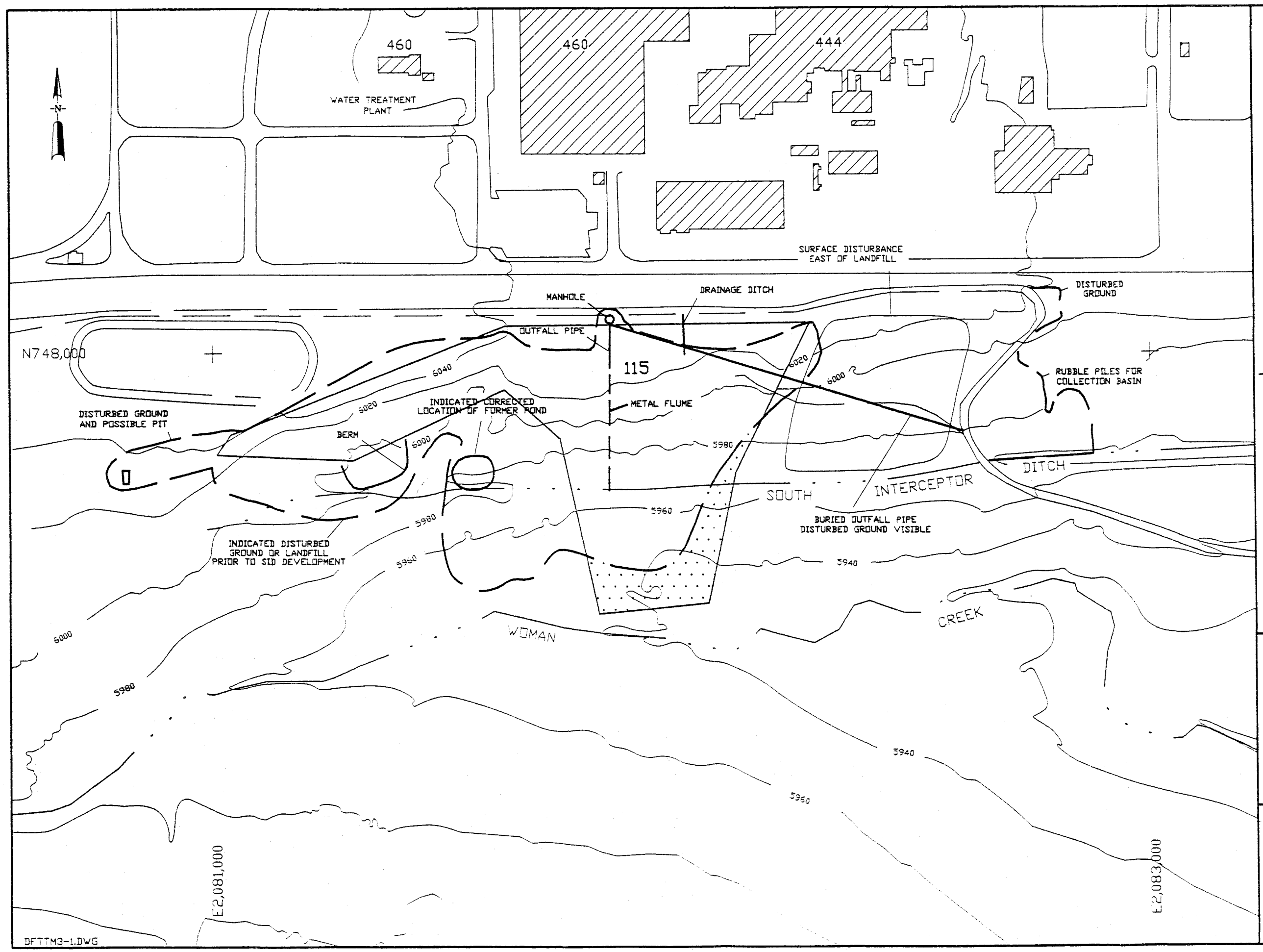
DATE/TIME		SAMPLE NUMBER	LOCATION	CONTAINER TYPE	NUMBER OF CONTAINERS	MEDIA SOIL(S) WATER (W)	FILTERED=F POT DISS=P	TURN AROUND RUSH =R	OUT OF SPEC REPORTS	PRESERVATIVE HCl	PRESERVATIVE HNO3				BOTTLE CODES	GROSS ALPHA / BETA	Pu 239/240 Am241	U 233/234,235,238	Sr89/90 Cs137 (1)	Th230/232,CM244,NP237	DISS GROSS ALPHA/BETA	DISS Pu 239/240 Am 241	DISS U233/234,235,238	DISS Sr 89/90 Cs 137 (1)	DISS Th230/2 CM244 NP237	TRITIUM (H3)	RAD SCREEN
															R A											
															R B						*					
															R C						*					
															R D								*			
															R F								*			
															R G											
															R H											

RELINQUISHED BY	DATE/TIME		RECEIVED BY	DATE/TIME	

REMARKS * INDICATES FILTERED SAMPLE
(1) = Cs 134 WHEN BY GAMMA

SHIPMENT METHOD

LABORATORY USE ONLY	Y	N
PCKG REC'D/CUSTODY SEALS INTACT		
SAMPLE LABELS/COCs AGREE		
TEMPERATURE WITHIN SPECIFICATION _____C		
CORRECTED COPY ATTACHED		
PROBLEMS OR DISCREPANCIES		

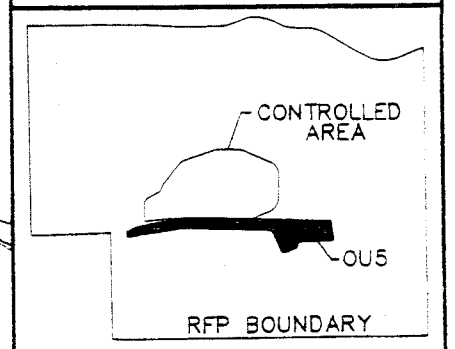


MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- 115 IHSS 115 ORIGINAL LANDFILL BOUNDARY (DOE, 1992)
- AMENDED LANDFILL BOUNDARY BASED ON AERIAL PHOTO REVIEW
- EPA AND CDH SOUTHERN EXTENSION OF LANDFILL BOUNDARY (DOE, 1992) INCLUDED IN THIS STUDY

0 100 200

SCALE: 1" = 200'



IHSS 115 ORIGINAL LANDFILL AND EXTENDED AREAS

OPERABLE UNIT 5 TECHNICAL MEMORANDUM 3

EG&G FIGURE 1

Rocky Flats Plant, Golden, Colorado

460

460

444

WATER TREATMENT PLANT

SURFACE DISTURBANCE EAST OF LANDFILL

DISTURBED GROUND

DRAINAGE DITCH

OUTFALL PIPE

RUBBLE PILES FOR COLLECTION BASIN

N748,000

5040

5020

5000

5980

5960

5940

6000

6020

SP-2

B-7

B-8

C-8

C-9

5980 BURRIED OUTFALL PIPE

SOUTH INTERCEPTOR DITCH

P-2

D-3

W-11

W-8

WOMAN CREEK

W-2

E2,081,000

E2,083,000

DFTTM3-2.DWG

MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- AMENDED LANDFILL BOUNDARY BASED ON AERIAL PHOTO REVIEW
- 1990 GAMMA SURVEY HOT SPOTS (DOE, 1992)
- EPA AND CDH SOUTHERN EXTENSION OF LANDFILL BOUNDARY (DOE, 1992) INCLUDED IN THIS STUDY
- 13 — ^{238}U (pCi/g) ISOCONCENTRATION CONTOURS (DOE, 1992)

0 100 200

SCALE: 1" = 200'

CONTROLLED AREA

OU5

RFP BOUNDARY

IHSS 115 ORIGINAL LANDFILL RADIATION SURVEY HOT SPOTS

OPERABLE UNIT 5 TECHNICAL MEMORANDUM 3

EG&G FIGURE 2

Rocky Flats Plant, Golden, Colorado

NOTE 1: Proposed Surface Soil Sample Location Numbers Correspond To Sample Location Nomenclature Shown In Table 3 As Follows 60 = SS506093

NOTE 2: Proposed Surface Soil Sample Location Number 63 Is Void.

460

460

444

WATER TREATMENT PLANT

SURFACE DISTURBANCE EAST OF LANDFILL

MANHOLE

DRAINAGE DITCH

DISTURBED GROUND

OUTFALL PIPE

N748,000

RUBBLE PILES FOR COLLECTION BASIN

METAL FLUME

DISTURBED GROUND AND POSSIBLE PIT

BERM

SOUTH INTERCEPTOR DITCH

BURIED OUTFALL PIPE DISTURBED GROUND VISIBLE

INDICATED CORRECTED LOCATION OF FORMER POND

INDICATED DISTURBED GROUND OR LANDFILL PRIOR TO SID DEVELOPMENT

WOMAN CREEK

6000

5960

5990

5940

5960

E:2,081,000

E:2,083,000

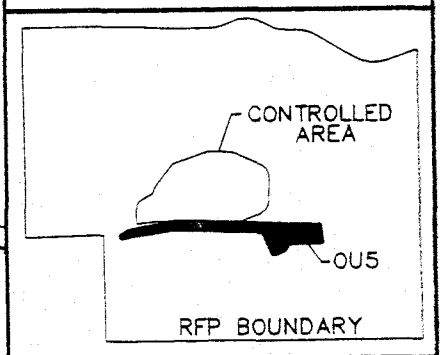
DFTTM3-3.DWG

MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- AMENDED LANDFILL BOUNDARY BASED ON AERIAL PHOTO REVIEW
- EPA AND CDH SOUTHERN EXTENSION OF LANDFILL BOUNDARY (DOE, 1992) INCLUDED IN THIS STUDY
- 102 × PROPOSED SURFACE SOIL SAMPLE LOCATIONS

0 100 200

SCALE: 1" = 200'



IHSS 115 ORIGINAL LANDFILL AND DISTURBED AREA SURFACE SOIL SAMPLE LOCATIONS

OPERABLE UNIT 5 TECHNICAL MEMORANDUM 3

EG&G FIGURE 3

Rocky Flats Plant, Golden, Colorado